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SOIL CONSERVATION SERVICE

REGION 6

TIE PRESERVATIVE TREATMENT OF FENCE POSTS

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THE PRESERVATIVE TREATMENT OF FENCE POSTS

Farmers and ranchers have always used large numbers of fence posts. Perhaps, the various native junipers have been used more than any others, but now that good juniper posts are becoming more difficult to obtain it is often necessary to use other kinds of woods. Some of the other native woods are very durable in contact with the soil and therefore make good posts, but others are not durable. This summary of some of the available information on fence posts and their treatment with preservatives has been prepared in order that farm planners and others may have a better understanding of the values of various fence post woods and of preservative treatments for the non-durable woods.

The material in this bulletin has been obtained from a variety of sources. The only contribution by the Forestry Division has been the compilation and summarization of material that appeared to have the greatest application in Region 6. The references at the back of the bulletin list all the sources from which material was obtained. When material was used more or less verbatim a number in parenthesis refers to the reference. So much source material was used that it is difficult to select the ones used the most but perhaps they are the various publications of the Forest Products Laboratory and the bulletin "Fence Posts" published by the Forestry Division, Region 7 (now Region 5) of the Soil Conservation Service, Lincoln, Nebraska.

The durability of wood is a variable property, with certain kinds showing a marked resistance to decay, others moderate resistance whereas the majority of woods show little resistance. The sapwood of all seasoned woods is readily susceptible to decay, whereas in many woods the heartwood is relatively resistant. The greater durability of heartwood is primarily the result of certain chemical changes taking place in its development. The heartwood of some of the cedars and junipers contains volatile oils and water-soluble chemicals of high toxicity, pitchy or resinous pines contain turpentine and pine oil, and some of the oaks apparently contain tannin. These materials are more or less toxic to decay-producing fungi and therefore tend to retard their development. Woods not resistant to decay can have their durability noticeably increased by impregnating them with toxic preservatives which poison the food supply of the decay-producing fungi.

Conditions necessary for the development of decay-producing fungi in wood are: (1) a supply of suitable food, (2) a sufficient degree of moisture, (3) at least a small amount of air, and (4) a favorable temperature. A deficiency in any one of these requirements will inhibit the growth of fungi. All of these requirements are usually present wherever posts are set in this Region so if non-durable woods must be used then it becomes necessary to treat them with a good wood preservative

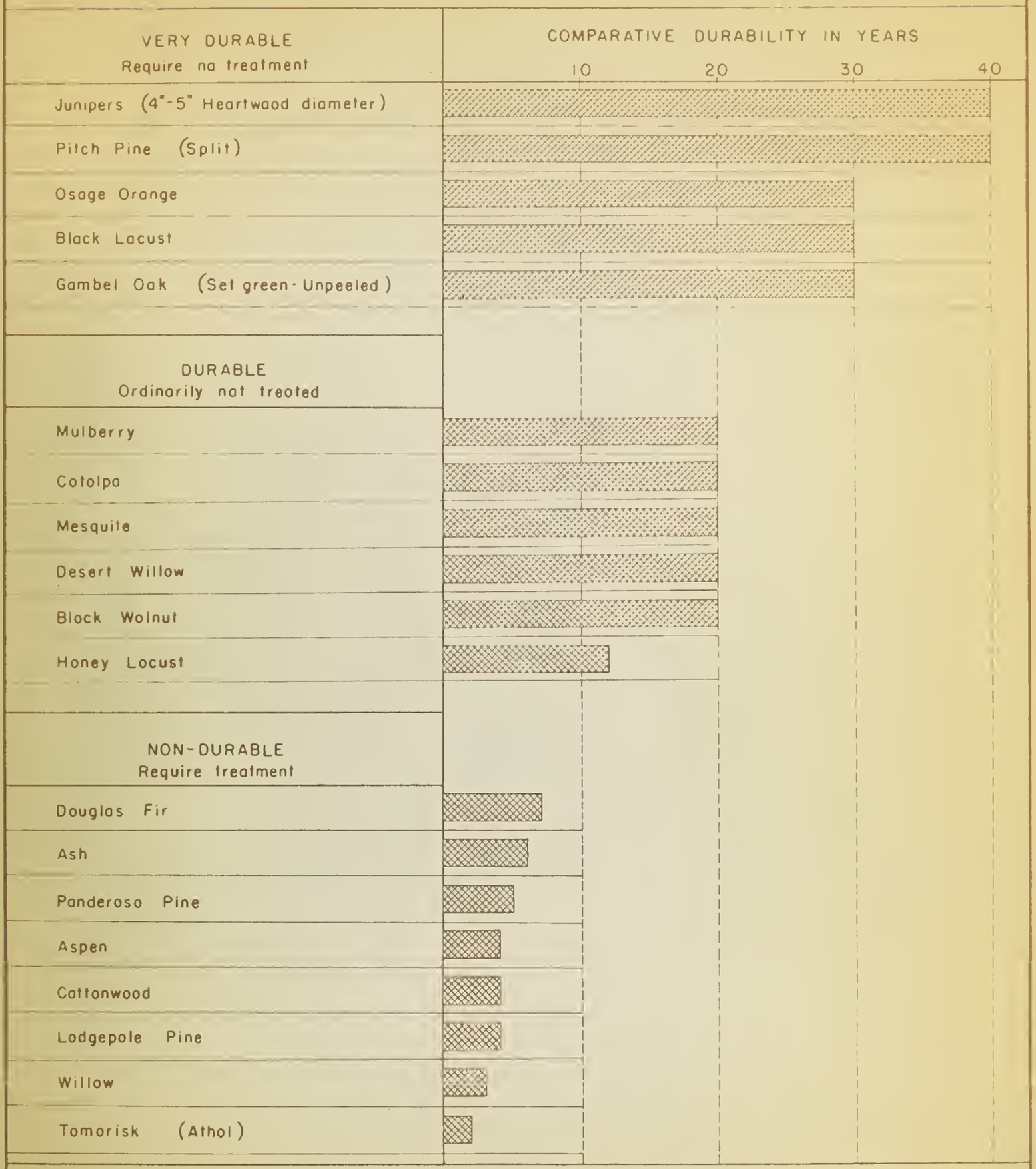
There are, however, many native woods that are very durable in contact with the soil. Table I - Comparative Durability of Untreated Fence Posts - list the more common woods available in the Region with their relative durability. Those listed as "very durable" and not requiring treatment will be described.

Junipers (also called cedars) (2)

All of the junipers (Juniperus sp.) have been used in this Region since pioneer days and are considered as the standard fence post material. The heartwood is

Table 1

COMPARATIVE DURABILITY UNTREATED FENCE POSTS

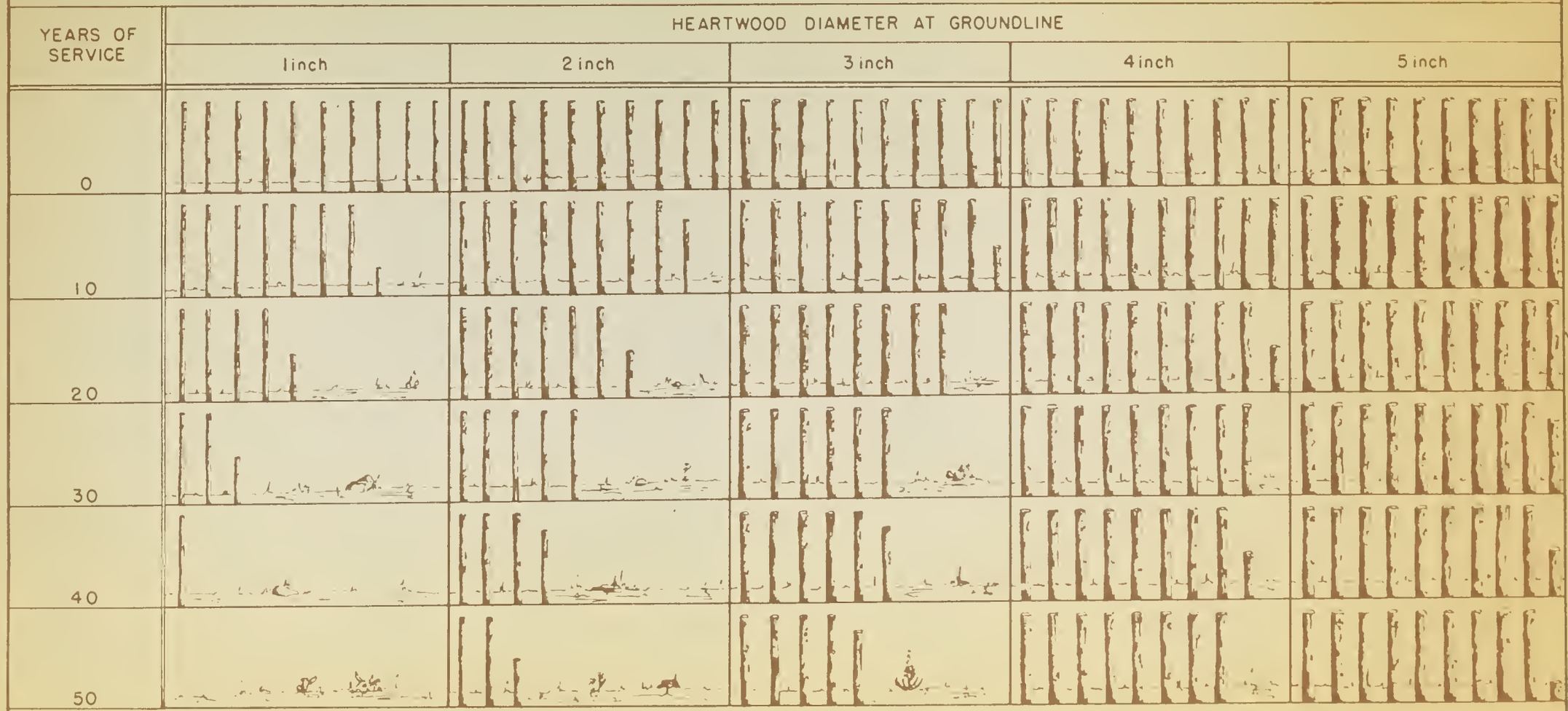


Data obtained from various sources

Table II

SERVICE LIFE OF JUNIPER POSTS

PERCENTAGE OF JUNIPER POSTS WITH VARIOUS HEARTWOOD DIAMETERS
SERVICEABLE AFTER 10, 20, 30, 40 AND 50 YEARS
EACH POST REPRESENTS 10 PERCENT



Data obtained from Research Report No 89, Sept 1940
Service Life of Untreated Juniper Fence Posts in Arizona
Southwestern Forest and Range Experimental Station

6-L-11,825

very durable but, because of the varying amount of heartwood in posts of various sizes, there is a big difference in the durability of juniper posts. The importance of heartwood content is shown in Table II - Service Life of Juniper Posts - which shows that posts with less than 3 inches of heartwood at groundline are relatively non-durable and should not be used in permanent fences unless treated with a good preservative.

Pitch Pine (split) (1)

Pitch pine posts are cut from dead pine trees that have seasoned on the stump. Trees that have been subjected to light ground fires gradually develop "cat faces" which are charred, pitchy scars at the base. When the cambial (growing) layer has been injured by fire, the tree endeavors to protect the wound by exuding large quantities of pitch and the wood directly below the scar rapidly becomes completel saturated with resin. This infiltration of resinous materials is essentially nontoxic, but acts as a waterproofing layer, preventing the penetration of wood destroying fungi. When the tree dies, it gradually seasons and the entire butt log may be impregnated with pitch. Such posts are invariably charred and many ranchers and farmers are accustomed to consider any posts that are charred as durable as "pitch posts." Douglas fir posts charred ¼ inch deep had an average life of 70 months, compared with 84 months for untreated Douglas fir. This indicates the futility of this practice. A good "pitch post" is split from a large log, it consists entirely of heartwood, and is so pitchy that a sliver taken from it readily ignites and burns freely. Several years ago the Southwestern Region of the Forest Service carried out a study to determine the practicability of "pitching" pole size pine trees 10 to 12 inches in diameter by various degrees of peeling. Over a period of 2 years the peeled portions of these trees became impregnated with irregular resin deposits varying from a trace to ¼ and ½ inches deep. The conclusions from this study were that even where satisfactory resin deposits were obtained the cut poles could not be considered anymore durable than untreated poles, because after the poles were cut they became checked forming openings into wood containing no resin. These openings permitted the entrance of fungi and moisture and resultant decay.

Osage orange (Hedge apple, Bodock, Bois D'Arc, Mock orange)

Good fence post material. Plant can be grown throughout the Region. Is moderately drought resistant and hardy.

Black locust

Good fence post material. Growth of plant is limited to Utah, northern Arizona, and western New Mexico because of black locust borer in other sections of Region. Wood is heavy and hard with thin sapwood.

Gambel oak (Quercus utahensis - Utah oak) (4)

Gambel oak is found throughout the Region and has been used extensively for fence posts. Round posts of Gambel oaks, 7 to 10 inches in diameter, set green and unpeeled have been found to be serviceable for 30 to 40 years. Smaller diameter posts are decreasingly less durable. Seasoned or peeled posts proved less durable. It is not definitely known why the green unpeeled posts are so much more durable than the peeled seasoned ones, although it is suspected that the tannin in the bark retards the action of decay-producing fungi. Gambel oak is an ideal tree for the production of fence posts because it grows in clumps, has a diameter range of 3 to 12 inches, and has few branches on the lower part of the tree.

Preservative Treatment of Non-Durable Fence Post Woods

All woods listed in Table I as "non-durable" should be treated with a good wood preservative before being used as fence posts. Many of these woods, particularly Douglas fir, ponderosa pine, lodgepole pine, pinon pine, and cottonwood are used extensively throughout the Region without being treated. This practice necessitates continual fence post replacement, which as any farmer or rancher knows can amount to a rather sizeable annual job. To figure post cost properly, it should be based on the cost per post per year - the annual post cost.

An Example of Annual Post Cost
Untreated and Treated Pine

Cost figures used in this example are averages. Annual comparative costs can be obtained for any work unit by using local cost figures and local data on durability of treated and untreated posts.

Untreated Pine

Average life of post	5 years (high)
Cost of post	$.15
Cost of digging hole, setting post and stapling (1/2 man hour)	.25
	$.40

$.40 ÷ 5 years = $.08 - annual post cost

Treated Pine (with any good preservative)

Average life of post	15 years (conservative)
Cost of post	$.15
Cost of treatment (materials and labor)	.20 (high)
Cost of digging hole, setting post and stapling (1/2 man hour)	.25
	$.60

$.60 ÷ 15 years = $.04 - annual post cost

This example is indicative of the savings farmers and ranchers can make by using treated fence posts instead of untreated ones with a short life. The "cost of treatment" figure of 20 cents is high, because by the use of some preservatives it can be done for as low as 10 cents per post. The "average life" figure of 15 years is conservative because by the use of creosote (hot and cold method) this can be increased to 20 years. Using these last two figures, we have a total treated post cost of 50 cents ÷ 20 years, which gives an annual post cost of $.025.

Comparative Annual Fence Post Costs Per Mile of Fence

Pine Posts	Life in Years	Annual Post Cost	Posts 1 rod apart (330 per mile)	Posts 2 rods apart (165 per mile)
Untreated	5	$.08	$ 26.40	$ 13.20
Treated	15	.04	13.20	6.60
Treated	20	.025	8.25	4.13

Although the original cost of treated fence posts may appear to be high, it is readily apparent that they are much cheaper over a period of even a few years than untreated non-durable fence posts.

Kinds of Preservatives (5)

There are a large number of good wood preservatives on the market but only a small number of them are adapted for use by farmers.

"Wood preservatives are chemicals that, when injected into wood, make it unpalatable or uninhabitable to wood-destroying organisms. For protection against decay marine borers, and most insects, preservatives must be poisonous or toxic. Protection against powder-post beetles can be accomplished by any film that covers the surface of the wood so that the insects cannot deposit their eggs in the pores. There may also be some chemicals that are repellent to insects rather than poisonous. For general use, however, a preservative must have high toxicity. It must also be chemically stable and permanent so that it will remain in the wood for many years, have good penetrating properties, be safe to handle, harmless to wood and metal, readily available, and reasonably cheap. Additional requirements for special uses may include cleanness, paintability, freedom from odor or color, fire resistance, moisture repellence, freedom from swelling, or various combinations of these properties."

"There are many materials that are capable of extending the life of wood. Naturally some are more effective than others; all possess certain disadvantages that limit their use, as well as advantages that make them especially suitable for specific purposes. The effectiveness of preservative treatment, of course, depends on the amount of preservative absorbed and the depth of penetration, as well as on the preservative used, and the importance of this fact must not be overlooked. With few if any exceptions, preservatives fall into three general classes: the toxic oils, like creosote, which are relatively insoluble in water and of low volatility; the salts that are injected into wood in the form of water solutions; and preservatives that consist of a small percentage (usually about 5 percent) of a highly toxic chemical in a solvent or mixture of solvents other than water."

THE CREOSOTE METHOD OF TREATING POSTS

"Coal-tar creosote is a brownish oil that comes from the distillation of coal-tar. It is the distillate that falls between the lightest fractions or light oils, and the pitchy substance that represents the residue. Its advantages are (1) its toxicity to wood-destroying fungi and insects, (2) is relatively insoluble in water, and its low volatility which impart to it a great degree of permanence, under the most varied conditions, (3) its ease of application, (4) the ease with which its depth of penetration can be determined, and (5) its general availability and relative low cost."

Creosote for use on posts and other farm timbers using the open-tank treatment should have the following specifications which are the same as those of the American Wood Preservers Association for Grade 1 creosote:

1. The creosote shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:
2. It shall not contain more than 3 per cent of water.
3. It shall not contain more than 0.5 per cent of matter insoluble in benzol.

4. The specific gravity of the creosote at 38°C., compared with water at 15.5°C., shall be not less than 1.03.
5. The distillate, on a water-free basis, shall be within the following limits:
   Up to 210°C., not more than 5 per cent.
   Up to 235°C., not more than 25 per cent.
6. The creosote shall yield not more than 2 per cent of coke residue.

"Preparing Round Posts for Creosoting necessitates that they be thoroughly peeled to enable them to season quickly enough to avoid decay or insect damage and in order to permit the entrance of the preservative. No preservative will penetrate bark easily. Peeling can be accomplished very easily if posts are cut during the spring months when the cambium layer is active. At other times of the season, the bark comes off with considerable difficulty and may require a special peeling spud or a draw shave, in addition to an ordinary axe."

"Seasoning is important. It is not uncommon in commercial practice to season posts, poles and railway ties for as long as 8 to 12 months before creosoting. A great deal can be accomplished in three to six months of good seasoning weather. Small pieces season more quickly than large pieces and sapwood more quickly than heartwood. The most satisfactory seasoning practice for any specific case will depend on the individual drying conditions and the preservative treatment to be used, and must be determined by experience."

"Preservative oils applied to green or wet wood are practically useless because preservatives so applied cannot penetrate wood that is already full of water."

"Preparing the Treating Solution.

A solution of 40% creosote and 60% light fuel oil has been found satisfactory. Old crankcase oil is a satisfactory substitute for fuel oil. The quantity of preservative that posts will absorb depends upon the species, the amount of seasoning, the size of the post, and the thoroughness of the job of treating. One gallon will usually treat from 2 to 4 posts."

"Necessary Equipment

The essential parts of the apparatus for general farm use are one or two tanks (depending on whether the hot and cold or hot and cooling method is used), a thermometer, and some means of heating."

"The chief requirements of the tanks are: (1) That they shall be strong enough to hold the weight of the oil and the posts; (2) that they shall not leak; (3) that they shall be deep enough, so that the surface of the oil will be a foot or more below the top of the tank during treatment; and (4) that they may be readily heated. Any metal tank of convenient size which will satisfy these requirements will do. The heating may be accomplished by a fire beneath the tank or by means of steam coils. If an open fire is used, care should be taken to prevent the oil from slopping over the side of the tank and taking fire. This is the reason for having the surface of the oil a foot below the top of the tank. Though the oil is not dangerously inflammable, and ordinary care will prevent trouble, carelessness may result in the loss of the oil and the posts. The treatment should be made, of course, in a situation where an accidental fire will not endanger any buildings, crops, or other valuable property."

"A 50-gallon drum is not suitable because it is too short. When a 1-foot section (cut from a barrel of the same size) has been welded to the top of a 50-gallon drum, it will be satisfactory. In order to keep the posts from floating in the oil, it is well in a plant of this kind to use a false bottom in each drum. This can readily be made out of the heads cut from the drums, or any flat piece of iron by riveting on strips of iron through which several screws protrude from one-half to three-fourths of an inch. The screws stick into the posts and keep them from moving about and floating in the oil."

The Treating Process.

The brushing or spraying of seasoned wood with creosote is a common practice, but because of the penetration obtained by either method is extremely shallow only very limited protection may be expected. The zone of treated wood is easily broken through with the result that untreated wood is exposed to fungus attack. The amount of preservative available per unit of surface area is also so small that, when the wood is exposed to the weather, it is rapidly reduced below the point of effectiveness.

The only really satisfactory method adapted for use by farmers and ranchers in applying creosote to posts and other farm timbers is known as the "hot and cold" method. In this method the seasoned posts or other seasoned materials are heated for one or more hours in the preservative at a temperature of from 180° to 220° F. They are then quickly transferred to a tank of preservative having a temperature of about 100°, and are left there for one hour or more. In the hot bath the air and moisture in the wood expand and are partially driven out. When the wood is plunged into the cool oil the air and moisture in the wood contract and draw in the oil. Except for a few very easily treated woods, there is little absorption of oil by the wood during the hot bath. Instead of a separate tank being used for the cool bath, the heating of the oil in the hot bath may be stopped and the wood and the oil allowed to cool together. This accomplishes the same purpose as the cool bath, but a longer time is required because the hot oil cools very slowly The single-tank treatment is particularly suitable for heavy posts, poles or large timbers which cannot be easily transferred from one tank to the other. It can sometimes be used to advantage also by heating for two or three hours early in the morning or in the evening and allowing the material to cool all day or all night. This will make it possible to carry on the treatment without interference with the regular work of the farm. The material may be treated more rapidly, however, by using the two tanks."

"It is desirable in the hot and cold bath treatment to have the sapwood penetrated all the way through by the oil. This is sometimes very difficult to accomplish, however, or requires too much oil, and a shallower penetration must then be accepted. A penetration of from one-half to three-fourths of an inch should give very good results. Even lighter penetrations, though they are not as effective, will probably give sufficient protection to more than repay the cost and inconvenience of treating. The treatment should extend far enough up the post so that at least 6 inches of treated wood will be above the ground line when the post is set. During the cooling period the absorption of oil by the posts will lower the height of the oil in the tank. Care should, therefore, be taken to see that there is always enough oil in the tank to keep the oil to the proper height on the posts."

"The length of time the wood is held in the hot and cold baths should be determined by the penetration obtained and the amount of oil absorbed. The most efficient treatment is the one that gives the greatest penetration with a moderate

absorption of oil. The depth of penetration may be determined by boring a small hole in the treated wood at the point where the ground line will be. This hole should be tightly plugged with a creosoted plug before the post is set. The reason for taking the depth of penetration at the ground line is that this is the point at which decay is usually most severe, and therefore the point at which depth of treatment is most important.

"Ordinarily it will not be necessary to leave the posts or other material in the hot bath over three hours, and with many woods a much shorter time may give good results. The same is true of the cold bath. If the penetration of oil is not sufficient, either the time of the hot or the cold bath should be lengthened. If the penetration is satisfactory, but too much oil is absorbed, the time of the cold or cooling bath should be shortened. Material wet from recent rains requires a much longer time for the hot bath than dry material. The amount of oil absorbed will vary with the kind of wood and the size of the material. In general for posts it should be between four-tenths and six-tenths of a gallon for a post 5 to 6 inches in diameter. The objection to higher absorptions is the greater cost for oil. In purchasing oil it should be remembered that in addition to the oil absorbed some oil will be left in the tank after the last posts or other material are removed. The quantity will depend on the size of the tank, but will be enough to fill the tank to a depth of about 1½ to 2 feet."

"During the heating period the temperature of the creosote should be kept as nearly constant as possible, or, still better, it should be allowed to increase very slowly. If it can be avoided, the temperature should not be allowed to fluctuate. Temperatures between 200° and 220° F. are satisfactory. For timber which treats very easily 180° may prove high enough. The temperature should not be allowed to go above 220°, as some of the oil is lost by evaporation at high temperatures. There is also danger that the oil will boil over the sides of the tank if the temperature gets too high. The "cold" bath should be warm enough to thin the oil thoroughly. A temperature of 100° will usually be found sufficient for this purpose."

Special Creosote Treatment of Tamarisk

The tree tamarisk, Tamarix aphylla, which is confined mainly to central and southern Arizona grows very rapidly and is an excellent fence post wood when treated with creosote. The untreated wood lasts only a few years. The tamarisk has capillary vertical vessels making it possible to treat either green or seasoned posts merely by placing them in a tank of cold creosote, which should have a depth of about 32 inches. With the creosote at this depth it will travel upwards to the top of a 7 foot post impregnating the entire post in a 12 hour immersion period. For further information on the treatment of tamarisk see reference 9.

"Summary of the Creosoting Process (Special Tamarisk method excluded)

1. Peeling of posts is necessary to hasten seasoning and to insure the penetration of the preservative.

2. Wet wood will not allow the penetration of creosote oils. Posts should be seasoned for from one to six months.

3. Prepare the treating solution by mixing 40% creosote with 60% fuel oil or old crank case oil.

4. Provide an open tank that will allow the posts to stand on end, be submerged to one foot above the ground line, and the creosote still not come nearer than one foot from the top of the tank.

5. Heating should not be more than 220° F. Use a good thermometer.

6. Posts should be left in the bath until it cools below 100° F. or be transferred to another tank containing creosote having a temperature of about 100°.

7. The preservative should penetrate to a depth of ½ to 3/4 of an inch.

8. It is desirable that the top of the post be given a light application.

Life of Creosoted Treated Posts

Non-durable fence post woods given a good hot and cold creosote treatment will have their usable life increased by 15 to 20 years. This is based upon information accumulated over the last 30 years by the Forest Products Laboratory and cooperating agencies.

Post Life When Treated With Creosote (Hot and Cold Method)
Based on Information Obtained from Forest Products Laboratory

(All round posts)

Douglas fir	20 years
Ash	20 years
Ponderosa and lodgepole pine	20 years
Aspen and cottonwood	18 years
Willow and red maple	18 years

Advantages and Disadvantages of the Hot and Cold Creosote Method of Preserving Fence Posts (Special Tamarisk method excluded)

This method of treating posts, although very satisfactory, has several disadvantages:

1. The posts must be fairly well cured.

2. Care must be exercised to remove the bark to the cambium layer for proper penetration.

3. Special equipment is required in all cases and a special structure must be built if a fairly large number of posts are to be treated efficiently.

4. A continuous crew is required for efficient treating operations if a fairly large number of posts are to be treated in a limited period of time.

5. There is always a fire hazard if extreme care is not exercised to avoid overheating the creosote.

Advantages:

1. Long-time tests have proven that this treatment gives a long usable life to non-durable fence post woods and this treatment can therefore be recommended to farmers and ranchers without any qualifications.

THE ZINC CHLORIDE METHOD OF TREATING FENCE POSTS

"Zinc chloride is a water soluble wood preservative and is available in three forms: granulated, fused, and concentrated solution. In the granulated form it is in dry, white grains or small pieces which dissolve readily in water. It must be shipped in airtight containers for, when exposed to air, it quickly takes up moisture and the grains stick together or even melt in the absorbed water. When using this form, therefore, it is desirable to mix the entire contents of the container with water at one time whenever practicable. If any unused granules mus be left in the container it should be tightly closed as quickly as possible."

"The fused form is very inconvenient to handle in small quantities. It is shipped as a solid mass inside of an airtight container. It can be dissolved slowly by chopping holes in the container and placing both container and contents in the water or the container may be chopped to pieces and thus removed from around the zinc chloride mass. Since fused zinc chloride, when purchased in small quantities is no cheaper than the granulated form, and may even be more expensive, there is seldom any advantage to the small consumer in using it."

Ordinarily the most convenient form of zinc chloride for small users is the concentrated solution. Various manufacturers ship the solution in different strengths and as this requires considerable figuring in order to determine the required strength of solution, it is not considered too satisfactory for the trough method. Either the granulated or fused forms are much easier to use in this method.

Tho principal advantages of this salt are its relative cheapness, general availability, uniformity of quality, cleanliness, ability of the treated wood to take and hold paint, lack of odor, ease of shipment, and lack of fire hazard. The use of zinc chloride as a preservative is not new. It has been used for a number of years and is practical for use in this Region.

"One of the simplest and cheapest methods that can be used for the treating of posts with zinc chloride is by the tire-tube method. This process is not altogether new but rather is the practical application of a treating process that has been in existence for a number of years. It requires a limited amount of equipment and lends itself especially to farmer treatment of posts, since it can be carried on periodically and does not require extensive preparation."

Because of the inability to obtain inner tubes at the present time, it becomes necessary to provide a substitute method which is known as the "trough method". This method has been thoroughly tried and if the directions are followed will give satisfactory results. However, if anyone is interested in the tire-tube method, the Regional Forestry Division will be glad to supply instructions on its use.

The Trough Method of Treating Posts with Zinc Chloride

"Trees the proper size for posts should be felled and cut into the desired lengths not more than 24 hours before they are to be treated. In the case of pine, it has been found that a 24-hour period is desirable before treating starts. This allows the pitch to accumulate on the ends of the posts."

"Mix the zinc chloride ($ZnCl_2$) in the proportions of 2 pounds of zinc chloride salt to one gallon of water. The salt will dissolve slowly and may require frequent stirring. Zinc chloride attacks metal and should not be allowed to stand for any length of time in a metal container. A wooden trough or half of a wooden barrel is the best type of container to use as a treating vat."

"If the posts have stood more than 2 or 3 hours after cutting, about 1 inch should be trimmed from the butt end, then the posts stood upright in the trough until it has been filled. If it takes more than 1 hour to fill the trough, place about 1 inch of zinc chloride solution in the bottom to prevent the trimmed posts from drying out. When the trough is filled to capacity with posts, zinc chloride solution should be added until there are two quarts for each cubic foot of wood contained in the posts in the trough. The table on page 13 shows the cubic contents of posts of different sizes."

"Let the posts stand in the solution for 3 days after which an inch should be sawed from the top end and the posts reversed (with the tops down) in the trough. Do not add more solution. There should be some left after the posts have been treated for three days. Leave the posts in the trough until all of the solution has been taken up. This will require from 2 to 4 days. The posts should then be removed, stacked, and allowed to dry for about 1 month before using."

The Pipe Method of Treating Posts With Zinc Chloride

Green posts can be treated with zinc chloride with an adaptation of the inner tube method which is known as the pipe method. A 1½ or 2 inch iron pipe, 8 to 10 inches long is sharpened at one end so that it can be driven into the top of a post. The post should be placed in an upright position and fastened so that it will not fall down, and the section of pipe then driven into the top of the post so that no liquids can leak out. The required amount of zinc chloride solution is then poured into the pipe. When all of the solution has drained into the posts then the posts are ready for setting. For information on the amount of preservative to use for posts of various sizes reference should be made to the inner tube method of treating posts with zinc chloride.

VOLUME TABLE FOR FENCE POSTS

Average Diameter in Inches	Volume in Cubic Feet for Given Lengths					
	5½ Ft.	6 Ft.	6½ Ft.	7 Ft.	7½ Ft.	8 Ft.
3.00	0.270	0.294	0.319	0.344	0.368	0.393
3.25	0.317	0.346	0.375	0.404	0.433	0.462
3.50	0.368	0.402	0.435	0.468	0.502	0.535
3.75	0.422	0.461	0.500	0.538	0.576	0.615
4.00	0.481	0.525	0.569	0.622	0.655	0.700
4.25	0.542	0.592	0.641	0.690	0.740	0.790
4.50	0.608	0.663	0.717	0.773	0.828	0.883
4.75	0.677	0.738	0.800	0.862	0.924	0.985
5.00	0.751	0.820	0.888	0.956	1.025	1.093
5.25	0.829	0.905	0.979	1.055	1.13	1.21
5.50	0.908	0.990	1.07	1.16	1.24	1.32
5.75	0.995	1.08	1.17	1.26	1.35	1.44
6.00	1.08	1.18	1.28	1.38	1.48	1.57
6.25	1.17	1.28	1.38	1.49	1.60	1.71
6.50	1.27	1.38	1.50	1.61	1.73	1.85
6.75	1.37	1.49	1.62	1.74	1.81	1.99
7.00	1.47	1.61	1.74	1.87	2.04	2.14
7.25	1.58	1.72	1.87	2.03	2.16	2.30
7.50	1.69	1.84	2.00	2.15	2.30	2.46
7.75	1.80	1.97	2.13	2.30	2.46	2.61
8.00	1.92	2.10	2.27	2.45	2.62	2.80
8.25	2.05	2.22	2.42	2.61	2.79	2.98

Determine the average diameter of the post.

$$\frac{\text{(Diameter of top} + \text{diameter of butt)}}{2}$$

Opposite this diameter in the above table (see the first column) and under the proper length, note the contents in cubic feet. Example: Consider a post of the following dimensions: Top = 3½" in diameter, butt = 3-3/4", length = 7 feet.

$$\frac{3\frac{1}{2}" + 3\text{-}3/4"}{2} = 3.62".$$

The nearest figure in the table corresponding to this diameter is 3.50". Under the column for 7 feet, and opposite 3.50, the volume in cubic feet = .468.

Compute the contents of all of the posts in this manner.

Testing the Penetration of Zinc Chloride

"Preparation of Testing Solutions

Prepare about 100 c.c. of each of the following stock solutions:

1% solution of potassium ferricyanide
1% solution of potassium iodide
5% solution of soluble starch

The soluble starch is not ordinary starch but a specially prepared starch which can be obtained from chemical supply houses. Two grams should be stirred with enough cold water to make a thin, uniform paste; then pour into enough hot water to make a total of 100 c.c., stir well and boil for a few minutes until nearly clear. This is important since all of the starch must be in solution. A starch solution will not keep long, and cannot be used with success when it begins to sour." *

"Application of Test

Cut a disc cross-section from the post or make a core boring with an increment borer.

Mix about 10 c.c. of each of the three stock solutions and pour into an atomizer. (Try to get a DeVilbiss No. 30 if possible). If an increment core is used, pour the solution into a test tube. When the mixture is sprayed on the sample, or when it is dipped into the solution, the disc cross-section of the post or the increment core will turn a deep blue where zinc chloride is present. That portion of the sample into which the zinc chloride has not penetrated will retain its original color. Should the color fade, repeat the process."

The Usable Life of Posts Treated with Zinc Chloride

Service records are not available on the life of posts treated by these methods.* However, records of posts treated with zinc chloride using other methods of application give the basis for expecting that very cheap post material, such as aspen, cottonwood, sapwood pine, soft maple, willow and others, by these treating processes will last fifteen years, and perhaps considerably longer in the drier portions of this Region.

THE OSMOSE METHOD OF TREATING POSTS***

The Origin of the Process

The Osmose process originated in Germany and has been used commercially since about 1930. Its use under this name is covered by two U. S. Patents issued in 1935.

The method of treatment is unique. It makes use of a new material which is applied in a thin water-mixed paste or a coal tar preparation which is carried into the wood by diffusion. The basic chemicals are sodium fluoride, sodium (or potassium) carbonate, and dinitrophenol, mixed with other ingredients. The two most important ingredients are sodium fluoride and dinitrophenol. Some of

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* Ordinary starch may be used if the other is not available.
** This refers to the inner tube, trough, and pipe methods.

their important values in comparison with other materials are given below:

Material	Solubility in Cold Water	Behavior Towards Moisture	Fungicide Rating
Common Salt	35.7	Hygroscopic	1
Zinc Chloride	209.0	Extremely Hygroscopic	5
Sodium Fluoride	4.4	Non-Hygroscopic	100
Dinitrophenol	0.07	Non-Hygroscopic	2000

Lumber treated with Osmose preservative that contains no creosote or tar is odorless and paintable. Freshly treated lumber is full of moisture and should be thoroughly seasoned after treatment before using it in buildings or other places where high moisture content or shrinkage after installation would be a disadvantage. The limited amounts of preservative salts absorbed in the Osmose treatment are too small to have a significant influence on the inflammability of the wood.

Service Tests Using the Osmose Process

The Forest Products Laboratory, in discussing the Osmose method, has the following to say:

"The only sure test of the value of a preservative or process is the results it gives in actual use. A long time is required to accumulate enough data on any process to permit positive conclusions as to its value. Observations must be made on many installations, under various conditions of service, and on different forms of timber, because the service life secured from any preservative or process will vary considerably as these factors vary. A few early failures of treated wood in service do not necessarily mean that the process is ineffective. The preservative may have been applied improperly or in inadequate quantity, or the conditions of service may have been abnormally severe. On the other hand, successful performance for a few years, or in a few cases, is not adequate evidence of high effectiveness. The results from a large number of installations must be considered together before the true picture is obtained. The Forest Products Laboratory has several installations of Osmose-treated fence posts under observation. The service data thus far available on Osmose-treated material are generally favorable, but are far too few to permit positive conclusions as to the effectiveness of the process."

Results After Five Years of Service

Aspen - Madison, Wisconsin - 6% in good condition, balance with butts decaying or removed because of decay. Treated with Osmosalts full length.

Southern pine - Madison, Wisconsin and Saucier, Mississippi. Posts at Madison, 100% in good condition, those at Saucier - 92% in good condition. Treated with Osmosalts full length.

***Much of this material was obtained from "The Osmose Process", a mimeographed memorandum by the Forest Products Laboratory, Madison, Wisconsin. Aug. 1941. This material has also been reviewed by the Osmose Wood Preserving Company representative in Denver, Colorado.

Lodgepole pine - Moscow, Idaho. None of treated material shows decay. Includes posts treated full length with Osmosalts and 30-inch butt treatment with Osmoplastic.

Results of tests conducted by Mississippi State Highway Department, Jackson, Mississippi. Test pieces were 4" x 4" x 4' sawed southern yellow pine, treated in accordance with the preservative manufacturers recommendations and set 2 feet into the ground. Soil condition in the test plot is of a marshy nature, which is very conducive to decay.

Untreated - All posts unserviceable because of decay in five years.

Coal tar creosote - pressure treated - 16 lbs. per cubic foot. All posts serviceable at end of 10-year period.

Zinc chloride - pressure treated - 1 lb. per cubic foot. At end of 8-year period, 44% of posts still serviceable.

Chromated zinc chloride - pressure treated - 1 lb. per cubic foot. At end of 8-year period, 48% of posts still serviceable.

Osmosar (Osmosalts) - brushed on - 1/4 lb. per cubic foot. At end of 8-year period, 97% of posts still serviceable.

Osmotite (Osmoplastic - binder - Gum Arabic) - brushed on - 1/4 lb. per cubic foot. At end of 6-year period, 94% of posts still serviceable.

Osmosar (Binder Gum-Arabic) - Brushed on 1/4 lb. per cubic foot. At end of 6-year period, 100% of posts still serviceable.

Wolman Salts - pressure treated - 1/3 lb. per cubic foot. At end of 7-year period, 97% of posts still serviceable.

The Recommendations of the Soil Conservation Service in Region 6

The tests listed above cover only a relatively short period of time, but they very definitely indicate that both Osmosalts and Osmoplastic do have excellent possibilities as wood preservatives, particularly when used on coniferous species. Tests are being carried on now with these two preservatives on hardwoods, mainly aspen, and as soon as we have any definite information it will be passed out to the field. Both preservatives are being used extensively by our Service in other regions, have been recommended by Extension Foresters in some of the eastern states, and are being used by some 60 leading utilities who have protected over a million poles. Because of its apparent value as a fence post preservative through tests and our own observations and its ready acceptance by Federal, State, and private organizations, we can recommend either the Osmosalts or the Osmoplastic to district and other cooperators. Since the tests conducted in Mississippi, where a much heavier rainfall and a greater prevalence of fungus and insects are experienced than in this Region, have shown a satisfactory survival after five and more years, we believe that posts treated by this method should last long enough to pay farmers and ranchers to invest in the necessary cost of treating.

Treating Instructions

Osmosalts for Posts and Lumber

1. Condition of Posts and Lumber

"Osmosalts is applicable only to green or moisture-laden timbers. The greater the sap or moisture content of the timber at time of application of treatment, the more rapid and deeper will be the initial penetration, because the Osmose process uses the moisture in the timber to dissolve the Osmosalts and obtains penetration by diffusion.

"The logs from which the round or sawed timbers are to be produced shall be branch-trimmed and cut to desired length immediately after the trees have been felled ... in the case of round posts the bark shall not be removed until just before treating. The treatment shall be carried out in such a manner that the application of the suspended mixture is made while the surfaces of the timbers are still wet with sap.

"Osmose treatment shall be applied by 'hand-brushing' or 'dipping'. The method to be used is dependent upon quantity, size and weight of timbers to be treated, and upon local field conditions. If the timbers to be treated are light enough in weight to be easily handled by hand, then the dipping method of application may be used. If the timbers are too large and heavy for dipping, or if the quantity to be treated is small, then the hand-brushing method of application is recommended."

2. Mixing Osmosalts

"Osmosalts are furnished in dry powder form and shall be mixed with water and stirred thoroughly so that the powder is in a uniform suspension and free from lumps. Due to the low solubility and colloidal properties of Osmosalts, the powder plus water mixed to specified densities results in a uniform suspension of free salts (powders) in the mix. During application, either by hand-brushing or dipping, the suspended mixture shall be stirred at frequent intervals to prevent settling ... thus assuring a uniform adherence of the preservative salts to the surface of the timbers. The ratio of dry salts to water to be used is dependent upon the size of timbers to be treated, and upon the strength (retention per cubic foot) of treatment desired.

"Unless otherwise specified, the consistency of the preservative mixture shall be such as to distribute uniformly over the exposed surfaces of the timbers to be treated, one-fourth ($\frac{1}{4}$) pound of dry Osmosalts per cubic foot of wood. This is equivalent to twenty-one (21) pounds of dry Osmosalts per one thousand board foot measure. Throughout the treating application, the density of the treating mixture shall be determined by means of hydrometer reading and the concentration of the preservative mixture accurately controlled."

At a cost of 49 cents per pound for Osmosalts delivered to Albuquerque, 1000 board feet of lumber can be treated for about $10.00 or 1 cent per board foot. A full length treatment of a 5-inch post will cost about 10 cents, half post treatment 5 cents.

It is possible to treat only the lower half of a post with Osmosalts, but since the entire post must be covered for a period of 20 days or more to allow penetration of the preservative, it may not be a good practice. While the posts are covered ideal conditions are established for decay, and as the top of the post has had no preservative treatment, decay in this portion may begin and continue after the post has been set in the ground. This is a point to be considered before treating only the lower half of posts with Osmosalts.

Data giving the hydrometer readings interpolated to pounds of Osmose salts per gallon of suspended mixtures, together with the details for a treating vat will be supplied by the Company when Osmosalts are ordered.

"The weight of water is computed at eight (8) pounds per gallon. To eliminate the necessity of weighing the Osmosalts when less than one hundred (100) pounds is to be used ... particularly for brush-treatment ... it is permissible to assume that a given liquid measure completely filled with the dry Osmosalts weighs the same as when filled with water."

3. Application of Preservative

"The Osmosalt Suspended Mixture shall be applied uniformly over all the surfaces of the timber to be treated so that no 'white wood' shows. If the hand-brushing method is used, one coat shall suffice. If the dipping method is used, the timber shall be momentarily immersed in the dipping vat so that all the surfaces are covered with the suspended mixture. After removing from the vat, timber shall be allowed to remain on the drain board for a few seconds, so that drippings shall drain back into the vat.

"After timbers have been brushed or dipped, care shall be exercised to prevent any of the Osmosalts adhering to the surfaces from being scraped or brushed off the wood, particularly when stacking."

4. Stacking Posts and Lumber

"All timbers, brushed or dipped, shall be stacked and covered the same day treated. After timbers have been brushed or dipped they are stacked (bulk-piled) for covering. The stacks can be of any shape but effort shall be made to eliminate unnecessary void space under covering. The lower layer of the stack should be 3" to 6" above the ground. The greater the quantity of timbers that are closely piled in a stack, the better will be the conditions for more rapid and deeper initial penetration."

5. Covering the stacks

"After stacking (at the end of each day) the stacks shall be completely covered with Osmose waterproofed covering material (or equal).* The object of this covering is twofold: (1) to prevent rain from washing the

* Tar paper, roofing paper or heavy tarpaulins will do the job.

Osmosalts off the wood surfaces prior to impregnation, and (2) to retain the moisture (sap) content in the wood by preventing any seasoning during the initial impregnation period. The covering paper shall be securely fastened down with battens of some kind placed along the laps of the paper so that it cannot be torn or blown off by wind. Then completely covered and dirt, sawdust, or some similar material shall be thrown around the base of the stacks to create as air-tight a condition as possible." When a large number of posts are to be treated, it may be advisable to build a small shack and line it with heavy paper so that it will be practically airtight.

6. Uncovering the Stacks

"The length of time that the timbers shall remain in covered stack is dependent upon certain variables. The recommended period shall be not less than 10 days for the first inch, plus 5 days for each additional inch of thickness or diameter."

Osmoplastic for Posts

1. Condition of Posts.

May be applied to either green or seasoned posts. Penetration is secured immediately on green posts, whereas penetration on seasoned posts takes place after post has been set and takes in moisture.

2. Applied only at the Ground Line.

"In many sections of the country the place where decay occurs in posts or poles is at and just below ground line. The only place above ground line where decay might occur is in bolt holes or contact points where moisture could lodge. Under these conditions the manufacturer recommends the Osmoplastic Ground Line Treatment."

3. No Mixing

Osmoplastic is furnished in metal pails of 5-gallon capacity, ready mixed and in 12-pound glass jars. The salts are suspended in a coal-tar solution of about the consistency of thick paint.

4. Application

Treatment of fence posts consists of applying Osmoplastic by hand with a brush over an area 2 inches above and 7 inches below ground line. Then wrap the 9-inch bandage over this area, fastening with galvanized roofing nail. Also apply Osmoplastic to both ends and contact points and any bolt holes above ground line.

One gallon of preservative will cover approximately 75 square feet of surface. One 12-pound jar will treat:

112 posts of 3-inch diameter
85 posts of 4-inch diameter
68 posts of 5-inch diameter

At a delivered price of $5.10 per gallon at Albuquerque, for the Osmoplastic and bandage, a post with a ground line diameter of 5 inches can be treated at a cost of about 7 cents for materials.

Considerable interest has been shown in the use of the Osmose method for preserving various types of irrigation structures. Very little information was available on this subject so the Company representative in Denver was asked some specific questions. Our questions and his answers follow:

Q. When used in irrigation structures, will not the water flowing over the treated boards wash out the salts?

A. Over a period of time the concentration of Osmosalts will be reduced. The important point is that the timber will be protected over a long period of time before leaching reduces concentration below effectiveness.

Q. Even though the salts are not washed out, will not the concentration of salts on the outside of the boards become less through leaching than that on the inside and cause the removal of the salts?

A. In our process we get a separation of the sodium fluoride and dinitrophenol. The sodium fluoride penetrates deeply while the dinitrophenol having a strong affinity to wood fibre attaches itself in the outer layers, (1/8" to 1/2"). This forms a protective wall for the sodium fluoride and just about prevents leaching.

Q. Has Osmosalts been used in irrigation structures of various kinds and with what degree of success?

A. Osmosalts have been used in irrigation structures, in fact they have been used in treatment of penstocks (water pipes). It should extend the service life 3 to 5 times that of untreated timber. It will provide a very definite saving in cost over pressure treated creosoted timber.

Treatment of Irrigation Structures and Other Types of Farm Timber

Various types of irrigation structures are constructed of wood and as a general rule they are placed in use without being treated with any type of wood preservative. It is known that pressure treated creosoted timber will give a long life to structures, but because of the expense involved and often the difficulty of obtaining this type of material it may be desirable to consider other types of preservative treatments. It is recognized that brushing or spraying creosote provides only a superficial coating of little value. If equipment is locally available it may be possible to treat lumber for irrigation structures with the hot and cold creosote method. If properly done this will give a long life to non-durable woods. Where it is impracticable to give lumber a good creosote treatment then the use of Osmoplastic should be considered. Osmoplastic is considered better than Osmosalts because it provides a protective covering of creosote, which should aid in reducing leaching of the salts. Osmoplastic applied to freshly cut or moisture laden lumber will penetrate rapidly and if the treated material is allowed to remain in the sun for a few days the outer layer of creosot will harden sufficiently to permit handling. It is desirable that all wood to be treated be "cut to fit" before treating and if during construction it is necessary to cut through treated material then Osmoplastic should be applied to the exposed surface. If treating before construction is impossible or impracticable it can

be delayed in most part until after construction providing that all joints, bolt holes and other vulnerable areas that will be covered when the structure is completed, be given a thorough application of Osmoplastic. The balance of the structure should be treated immediately after construction and enough time allowed before water is placed in such structures as flumes and irrigation structures, to allow the Osmoplastic to penetrate into the wood and form a hard covering on the outside. In treating wood with Osmoplastic one must not overlook the fact that the salts in the Osmoplastic will not diffuse into the wood unless moisture is present in the wood, so it is desirable to use freshly cut lumber when Osmoplastic is used as the preservative material.

Irrigation structures have been emphasized in the above discussion, but the Osmoplastic treatment is equally applicable to and should be used on any wood that is to come in contact with the ground or will in any other way be subject to decay. Wood used for any of the following should be treated: foundation timbers, bridge sills, barn door sills, bridge supports (treat contact points only), and other similar uses wherever the wood will come in contact with or be able to absorb or collect moisture.

Advantages and Disadvantages of Osmose Treatment

Advantages

1. Either green or cured wood may be treated with equal satisfaction, but better results are obtained by treating green or moisture laden timbers.

2. Less care need be taken in removing the bark.

3. No special structure is necessary for the treating process.

4. There is no fire hazard involved.

5. Treating can take place intermittently and at slack periods.

6. It is a much more convenient treating process than creosote.

Disadvantage

1. Experimental data has proven the worth of this material is limited to only 8 to 10 years use, although the toxic materials contained in this product indicate that wood treated with it may last considerably longer.

We know that farmers and ranchers within soil conservation districts would be interested in the use of this material so to encourage its use and also to show cooperators within districts another advantage of such an organization, we asked the Osmose Company for price considerations for cooperators in soil conservation districts. They were very gracious in granting district cooperators a reduction of about 10 percent from their standard price list. They did this because we were advising groups of farmers and ranchers whose orders, when pooled, would entitle them to lower price brackets. All material obtained at this reduced price must be ordered in the name of a soil conservation district. The orders which should never be in less than 5-gallon lots should be mailed directly to the Osmose Wood Preserving Company, Ernest and Cranmer Building, Denver 2, Colorado. The material will be shipped from the main offices at Buffalo, New York.

There is listed below the delivered price of Osmosalts, Osmoplastic, and the bandage for the Osmoplastic treatment for representative locations within the Region. The Osmose Company has the names of soil conservation districts located at these places, all of whom can obtain materials at the delivered prices quoted. Districts at other locations desiring any Osmose preservatives must first write the Regional Forestry Division so that their name can be submitted to the Company.

Utah	Osmosalts	Osmoplastic	Bandage
Salt Lake City	$ .49 per lb.	$4.50 per gal.	$ .70 per roll
Roosevelt	.50 per lb.	4.50 per gal.	.70 per roll
Huntington	.50 per lb.	4.50 per gal.	.70 per roll
Panguitch	.50 per lb.	4.62 per gal.	.72 per roll
Loa	.50 per lb.	4.50 per gal.	.72 per roll
St. George	.50 per lb.	4.50 per gal.	.72 per roll
Moab	.50 per lb.	4.50 per gal.	.70 per roll
Arizona			
Holbrook	$ .50 per lb.	$4.57 per gal.	$ .72 per roll
Safford	.50 per lb.	4.56 per gal.	.72 per roll
Tucson	.50 per lb.	4.56 per gal.	.72 per roll
New Mexico			
Clayton	$ .48 per lb.	$4.38 per gal.	$ .67 per roll
Clovis	.48 per lb.	4.35 per gal.	.67 per roll
Roswell	.48 per lb.	4.38 per gal.	.68 per roll
Alamogordo	.49 per lb.	4.41 per gal.	.69 per roll
Albuquerque	.49 per lb.	4.41 per gal.	.69 per roll
Farmington	.50 per lb.	4.62 per gal.	.72 per roll
Santa Fe	.48 per lb.	4.41 per gal.	.69 per roll
Colorado			
Colorado Springs	$ .48 per lb.	$4.35 per gal.	$ .67 per roll
Grand Junction	.50 per lb.	4.41 per gal.	.71 per roll
Montrose	.50 per lb.	4.41 per gal.	.72 per roll
Pueblo	.48 per lb.	4.30 per gal.	.67 per roll
Cheyenne Wells	.48 per lb.	4.30 per gal.	.67 per roll

Method of Checking for Penetration of Osmose Preservatives

Sodium fluoride, the basic preservative agent of Osmose compounds, which penetrate deeply into the wood, is colorless. Its depth of penetration in toxic concentration may be readily indicated by the alizarin zirconium reagent test* applied to either cross-sections of a treated pole or to borings of a pole taken with an increment borer. The procedure is as follows:

1. Allow cross-sections or borings to dry before testing.

2. The alizarin zirconium reagent, consisting of two solutions, is mixed just before using, as their effectiveness will last only a few hours after mixing.

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* Developed by the U. S. Forest Products Laboratory.

These solutions are known as Solution I and Solution II. To mix: One part of Solution II is poured into one part of Solution I. (Solution II is poured into one part of Solution I.) (Solution I MUST NEVER BE POURED INTO SOLUTION II.) The resultant mixture is a red fluid.

3. Make Solution I as follows:

Zirconium oxychloride - - - - - -	5 grams
Water - - - - - - - - - - - - - -	500 cc **

4. Make Solution II as follows:

Sodium alizarine sulphonate - - -	2 grams
Hydrochloric acid (Concentrated)	40 cc.
Water - - - - - - - - - - - - - - -	460 cc. **

5. The wood to be examined is then tested with this red solution. Borings are dipped into it for 20 to 30 seconds and cross-sections are sprayed with the solution. *** At first it stains the wood red. In 10 to 20 minutes, however, the red color changes to yellow wherever sodium fluoride is present in the wood in effective concentration.

The alizarin zirconium reagent test for sodium fluoride depends upon the reversal by soluble fluorides of the reaction between the zirconium salts and sodium alizarin sulphonate. The zirconium salt makes a brilliant red dye, but in the presence of any soluble fluoride the dye is not formed. Therefore, when the surface of a disc is sprayed with a solution of zirconium salts and sodium alizarin sulphonate, the whole disc is at first turned a bright red; but in a few minutes the presence of the fluoride is made manifest by the treated portions turning a brilliant yellow, which is the resultant color of the sodium alizarin sulphonate. The test is a negative one inasmuch as the color is discharged where sodium fluoride is present in toxic concentration.

TREATMENT WITH PERMATOX F

Various forms of Permatox have been used in the lumber industry for a number of years and the company producing these chemicals has now developed one known as Permatox F, which consists of 5% chlorinated phenols and 95% petroleum solvents. It is especially designed for general farm work and can be used for treatment of fence posts for control of decay and termites, in poultry houses for control of mites and ticks and in corn cribs and wheat bins for control of mold, decay and attack of termites. If fence posts alone are to be treated the company representatives recommend Permatox A, which consists of 5% pentachlorophenol and 95% petroleum solvents, but for general farm use Permatox F may be better.

Theoretically, the preservative value of Permatox under adverse conditions such as high humidity and heavy rainfall with intermittent changes in temperature, is excellent. Permatox A has a solubility in water of only 17 parts per million and Permatox F 112 at the same temperature of 26° centigrade.

** 500 cc equals approximately one pint of solution. If this is more than you will need, the quantities in the formula may be cut in half.

*** A small atomizer such as can be procured from ten cent stores or drug stores may be used.

Permatox F is a highly toxic material, practically colorless, and wood treated with this material can be readily painted when the concentrate is mixed with 10 parts of kerosene.

When treating fence posts with Permatox F, the best method is to cut the posts during the winter, let them air season until dry, and then soak for about 24 hours in Permatox F. One part of the Permatox to 10 parts of diesel oil or fairly clean waste crankcase oil. While this material is an effective wood preservative, it is only of value to that portion of the wood that it reaches. The longer the posts soak in the solution, the better the penetration and the longer the life obtained. Ordinarily, life is increased about 10 years.

Both Permatox F and A consisting of a high percentage of petroleum solvents should have possibilities for the treatment of various types of irrigation structures. Permatox A appears to be the better of the two because of its low solubility in water.

This material can be obtained from the A.D. Chapman and Company, Inc., 333 North Michigan Avenue, Chicago, Illinois, at about $5.00 per gallon.

EXAMPLES OF COST FIGURES ON TREATING FENCE POSTS WITH VARIOUS TYPES OF PRESERVATIVES *

I. Creosote Treatment - Data obtained from Northeastern Colorado LU Project, Briggsdale, Colorado.

A. Materials: creosote oil, A.W.P.A. #1 or Federal Specification 77-W-556:

1. Creosote F.O.B. Buckingham, Colorado, in 50- or 55-gallon drums; drums furnished by Soil Conservation Service, therefore no deposit was necessary.

Cost 29¢ per gallon, Denver, Colorado	$ .29
Freight at 45¢ per 100 lbs. to Buckingham, Colorado: 10.6 lbs. per gallon	.048
Total cost of creosote, per gallon	$ .338

2. Fuel Oil

Total cost fuel oil per gal, F.O.B. Buckingham	$ .08

3. Mixture

a. 50% creosote plus 50% fuel oil:

1/2 gallon creosote @ .338 per gallon	.169
1/2 gallon diesel fuel @ .080 per gallon	.040
Total cost of mixture	.209

b. 40% creosote plus 60% fuel oil:

2/5 gallon creosote @ .338 per gallon	.1352
3/5 gallon diesel fuel @ .080	.048
Total cost of mixture	.183

* A summary of comparative costs obtained from these samples is given on Page 28.

B. Labor

1. One man will peel (butts only) 20 posts per hour @ .50 per hour, per post	.025
2. One man will treat (butts only) 8 posts per hour @ .50 per hour, per post	.065
Total	.090

C. Total cost peeling and treating, using 50-50 mixture:

1. Labor, peeling and treating, @ 50¢ per hour	.090
2. Material, 50-50 mixture* 2 posts per gallon	.105
Total	.195

D. Total cost peeling and treating, using 40-60 mixture:

1. Labor, peeling and treating @ 50¢ per hour	.090
2. Material* 2 posts per gallon	.092
Total	.182
3. Labor, peeling and treating	.090
4. Material 3 posts per gallon	.061
Total	.151

II. Zinc Chloride Treatment - Tire tube method. Data obtained from Field Text on Grant Lands LU Project, New Mexico.

10% solution of zinc chloride

10-3/4 gallons of water
10 lbs. granulated zinc chloride

Summary Cost Record
200 Green Aspen Posts

Materials and Labor	Materials	Labor Man Hours	Labor and Material Cost	Unit Cost Per Post
Cutting & peeling		45	13.50	.0675
Peeling estimated at				(.01)
Clamping Tube		18	5.40	.0270
Treating		18	5.40	.0270
Zinc chloride	200 lbs.		25.00	.1250
Cost of Treatment			49.30	.2465

* No accurate record has been kept on the number of posts one gallon of mixture will treat; however, we estimate the requirements are fairly close to those set forth by Mr. R. E. Ford in the experimental data on treating lodgepole pine posts.

III. Osmoplastic Treatment - Data obtained from Northeastern Colorado LU Project.

A. Materials

1. Osmoplastic per gal. in 5-gal. containers, F.O.B. Denver	4.435
Freight from Denver to Buckingham, Colorado, @ 45¢ per 100 lbs., 14.4 lbs. per gallon	.065
Cost per gallon delivered to Buckingham	4.500
2. Bandage, 6 inch, 75¢ per roll	
2.2 rolls of bandage per gallon of plastic @ 75¢ per roll	1.650
Freight from Denver to Buckingham @ 45¢ per hundred lbs., or .0045 per lb., 2½ lbs. per roll and 2.2 rolls per gallon	.024
Total cost of bandage for 1 gallon material	1.674
3. Cost of 15 inch application.	
1 gallon Osmoplastic @ $4.50 per gallon,	4.50
2.2 rolls bandage costing 1.67 will treat	1.67
80 posts approximately 5" in diameter at ground line 3" above surface, 12" below.	6.17
Total cost material per post	.077
4. Cost of 9 inch application.	
1 gallon Osmoplastic @ $4.50 per gallon,	4.50
1.5 rolls 9" bandage @ .75¢	1.12
Freight from Denver to Buckingham on bandage	.017
Total cost material for 80 posts 5" in diameter at ground line. Treatment 2" above ground line, 7" below.	5.637
Total material cost per post	.0705

B. Labor

1. One man will peel 20 posts per hour (butts only) @ 50¢ per hour, per post	.025
2. One man will treat (ground line) 20 posts per hour (12" bandage)	.025
Peeling and treating post costs (6" bandage)	.05
Peeling and treating post costs (9" bandage)	.045

C. Cost of peeling and treating

1. Materials for 5" post ground line treatment	
3" above ground, 12" below	.077
2" above ground, 7" below	.0705
2. Labor for 5" post (ground line treatment)	
3" above ground, 12" below	.050
2" above ground, 7" below	.045

Total cost per post treating Osmoplastic	
15" treatment	.127
9" treatment	.1155

IV. Osmosalts Treatment - Data obtained from South Dakota Farm Forestry Project - Region 5.

Cost Table

1,300 Ponderosa Pine Posts Cut

Cutting -- 73 hours @ 60¢ per hour	$43.80
Peeling -- 90 hours @ 60¢ per hour	54.00
Treating Material -- 65 pounds @ 52¢ per pound	33.80
Covering Material -- ½ roll @ $13.00 per roll	6.50
Treating Labor -- 25 hours @ 60¢ per hour	15.00
Skidding -- 5 hours @ $1.20 per hour	6.00
Grading -- 8 hours @ 60¢ per hour	4.80
Total	$163.90

Cost per post 0.127

Posts were from 1 to 5 inches top diameter, most of them in 2 and 3-inch class. The posts were dipped in a vat of Osmosalt mixture and then removed to drain for a short while before being stored in tar papor lined sheds for 15 to 25 days.

V. Permatox Treatment - Data obtained from advertising folder distributed by A. D. Chapman and Company, Inc., 333 North Michigan Avenue, Chicago, Illinois.

10 gals. fuel oil or kerosene at 10¢ per gallon	$1.00
1 gal. Permatox F concentrate at	4.70
Cost of 11 gals. ready to use	5.70
Cost per gallon	.52

20 to 40 gals. will treat 100 3-inch to 4-inch seasoned posts, six feet long.

Cost per post varies from

20 gals. x .52 = $10.40 ÷ 100 posts = .104

40 gals. x .52 = 20.80 ÷ 100 posts = .208

COMPARATIVE COST FIGURES FOR
VARIOUS TYPES FENCE POST PRESERVATIVE TREATMENTS

Labor and Materials	Creosote (1) (Hot and Cold Treatment)		Zinc chloride (2) (Tire tube method)		Osmoplastic (3) (Salts & creosote)		Osmosalts (4) (Salts and water)	Permatox F (5) (Concentrate & oil)	
	Costs per post for peeling, treating materials and labor								
	Low	High	Low	High	Low	High	Average	Low	High
Peeling post	(Butts only) .025	.025	(Top only) .01	.01	(Butts only) .025	.025	(Entire post) .04	(Entire post) .04	.04
Treating material	(Butts only) .061	.105	.08	.12	(Ground line only) .0705	.077	.03	(Entire post) .10	.20
Clamping tube			.03	.03					
Covering material							.005		
Treating labor	(Butts only) .065	.065	.03	.03	.02	.025	.01	.01	.01
TOTAL COST PER POST	.151	.195	.15	.19	.1155	.127	.085	.15	.25

(1) Data from Northeastern Colorado LU Project - several thousand seasoned lodgepole pine posts treated. Line posts averaged 5 inches at groundline. Low costs 3 posts per gallon of 40% creosote, 60% diesel oil; high costs 2 posts per gallon of 50% creosote, 50% diesel oil. See pages 24 and 25.

(2) Data from Field Test on Grant Lands LU Project, New Mexico. 200 green aspen posts average diameter 5 inches at groundline. See page 25. Costs for trough method would be about the same, perhaps slightly lower.

(3) Data from Northeastern Colorado LU Project - several thousand green and seasoned lodgepole pine treated. Line posts averaged 5 inches at groundline. See Page 26.

(4) Data from South Dakota Farm Forestry Project, Region 5. 1300 green ponderosa pine posts, 1 to 5 inches top diameter. See page 27.

(5) Material costs based on Company statements for 3 to 4-inch seasoned posts, 6 feet long. See Page 27.

PREVENTING DAMAGE BY SUBTERRANEAN TERMITES

A great deal of interest has been shown in the control of termite damage and it therefore appears advisable to summarize some of the latest information available on this subject. Most of the material given below was obtained from Farmers' Bulletin 1911, "Subterranean Termites and Their Control".

"Effective protection against infestation by termites can be assured by careful observance of the following practices in the construction and maintenance of all buildings in which wood is used:

1. Remove all stumps, wood debris, and other cellulose material from the building site before construction is begun. If termites are found to be present in the soil, apply chemicals to kill them.
2. Remove all form boards and grade stakes.
3. Do not allow scraps of lumber and other wood debris to become buried in the backfill adjacent to the foundation or in fill material used under porches, terraces, or steps.
4. Place the building on a foundation that is impervious to termites.
5. Avoid all contacts between woodwork of the building and soil or fill.
6. Provide sufficient clearance beneath all parts of a building to give crawl space for making future inspections.
7. Provide ventilation openings in the foundation, arranged to prevent dead-air pockets and of sufficient size to assure frequent changes of air.
8. Provide for thorough drainage of the soil beneath the building.
9. Make thorough annual inspections for evidence of termite activity, such as shelter tubes on foundation surfaces."

"No wood is naturally entirely immune to attack by subterranean termites, but the heartwood of certain species of trees contains chemical extractives that are apparently repellent to them. This is particularly true for heartwood from trees that have made relatively slow growth. Sapwood is not resistant and should be removed from timbers that must be used in contact with the ground. Resistant woods that are available commercially include foundation grade California redwood (Sequoia sempervirens), all-heart southern tidewater red cypress (Taxodium distichum), and very pitchy or 'lightwood' longleaf pine (Pinus palustris). Eastern redcedar (Juniperus virginiana) is fairly resistant and often available in quantities and sizes suitable for use as posts, poles, bridge timbers, or other purposes." Our native junipers fall in the same class as Eastern redcedar.

Timbers or lumber that will come in contact with the ground should be thoroughly impregnated with a good wood preservative. The hot and cold method treatment with cold tar creosote is satisfactory and a good treatment with zinc chloride such as the trough method or pipe method will provide wood that is protected against damage by termites and decay. Lumber should be cut to finished length and all cutting and trimming should be done before treatment whenever possible. When cutting after treatment is unavoidable, the cut surface should be given several coats of a good wood preservative such as Osmoplastic which contains sodium arsenite.

"Chemicals toxic to subterranean termites can be used advantageously to check infestations present in the soil. They are useful in treating new building sites where termites have become established, as well as in serving as a valuable adjunct to structural changes for checking infestations in buildings. Chemical